Light and electron microscopic examination of human subungual tissue

Glomus and lamellated bodies

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ABSTRACT

Objective: There is only limited data related to the subungual glomus body. We therefore studied the structure of this organ, aiming to obtain further evidence. Additionally, we encountered undefined receptor like structures in close association with these glomus cells, named them as lamellated bodies and examined both of the structures at light and electron microscopic levels.

Methods: This study was carried out at the Faculty of Medicine, Hacettepe University, Ankara, Turkey, during the time period May 2001 to March 2002. In this study, the subungual tissues of 4 patients were examined.

Results: Within subungual tissue, 2 groups of morphologically significant structures were determined by light microscopy. The first structure was described as glomus body. It was characterized as an encapsulated structure, rich in rounded clear cells filling its central compartment. The latter structure having a lamellated appearance was described as lamellated body. In the electron microscopic examination, lamellated bodies were characterized by central filament rich large cells and surrounding cytoplasmic processes of ensheathing cells, some of which were vacuolated. Glomus bodies were surrounded by a capsule and centrally located numerous rounded cells which reflected the structural features of an active cell.

Conclusion: The lamellated bodies are very unusual structures and they are not found in any other part of the body. The structural organization of the ensheathing cells in the lamellated bodies greatly resembles many skin associated receptors. Therefore, we planned future studies by using immunohistochemistry, to reveal nervous elements for structural contribution.

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Glomus is a term, which refers to a specialized arterio-venous anastomosis. It is a Latin word for "ball of yarn" and consists of a vascular channel, the canal of Sucquet-Hoyer, surrounded by nodular aggregates of modified smooth muscle cells known as glomus cells.[1] The exact function of glomera is unknown, but is generally thought to be involved in thermoregulation. These structures are usually found in the nail beds, the pads of digits, in the external ear of humans[2] and in the pericoccygeal soft tissue ventral to the tip of the coccyx as microscopic structures.[3] The glomus bodies are highly concentrated in tips of the digits, particularly beneath the nails.[4] Each glomus body is a tiny encapsulated oval organ, approximately 300 μm long. The nail beds of fingers and toes contain 93-501 glomus bodies per square centimeter.[5] There is only

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limited data related with the subungual glomus body in classical textbooks.[2,6] Though there are some articles describing the light microscopic structure of the subungual glomus cells[7,8] and determining the magnetic resonance imaging features of these cells,[9] the data presented is rather conflicting, especially when comparing subungual glomus tumors and normal subungual glomus bodies.[7-11] We therefore studied the structure of the subungual glomus body at the light and electron microscopic level aiming to obtain further evidence. Additionally, during this examination we encountered undefined receptor like structures in close association with these glomus cells and named them as lamellated bodies. We also examined the structure of these undefined lamellated bodies at light and electron microscopic levels and have briefly reported our findings.

Methods. This study was carried out at the Faculty of Medicine, Hacettepe University, Ankara, Turkey, during the time period May 2001 to March 2002. In this study, the subungual tissues of 4 patients were examined. Two of these patients were male (33 and 42 years old) and 2 of them were female (28 and 37 years old). All the patients were admitted to the hospital due to a swelling in their forearms. Malignant soft tissue tumors at the distal parts of the forearms were found in the clinical examination and magnetic resonance imaging investigation of these regions. Below-elbow amputations were applied and the specimens of all of these patients were dissected for pathological and histological examinations. The subungual tissues taken from each finger of the patients (totally 20 subungual specimens) were dissected in a search for the glomus body. The specimens were then fixed by triple fixation. At first by 2.5% glutaraldehyde for 24 hours, washed in phosphate buffer (pH: 7.4), post-fixed in 1% osmium tetroxide in phosphate buffer (pH:7.4) for 2 hours and the third fixation was performed by 10% formalin for one hour and washed in phosphate buffer (pH: 7.4). Then the tissues were dehydrated in increasing concentrations of alcohol, washed with propylene oxide and embedded in epoxy resin embedding media. Semi-thin sections approximately 2 μm in thickness and ultrathin sections approximately 60 nm in thickness were cut with a glass knife on an LKB-Novo ultramicrotome. Semi-thin sections were stained with methylene blue and examined by a Nikon Optiphot light microscope. Ultrathin sections were collected on copper grids, stained with uranyl acetate and lead citrate and examined with a JEOL JEM 1200 EX transmission electron microscope.

Results. It was difficult to distinguish the subungual glomus bodies as separate entities with the naked eye. We therefore prepared several blocks from 20 fingers during gross anatomical dissection of the subungual region. From all these specimens, interestingly, in one index, 2 middle and one ring finger we observed glomus bodies in close association with structures having a lamellated appearance.

Light microscopy. Subungual tissue consists of largely dermal tissue revealing dense irregular connective tissue outline. Within this tissue, 2 groups of morphologically significant structures were determined in addition to several sections of regular vasculature. The first structure is described as glomus body. It is characterized as an encapsulated structure; rich in rounded clear cells filling its central compartment (**Figures 1a and 1b**). The latter structure having a lamellated appearance is described as lamellated body. Several sections of these structures were encountered in the close vicinity of glomus bodies. Structurally, cross and oblique sections of lamellated bodies always exhibit a centrally located, huge cell with a rounded nucleus and large, pale cytoplasm. Surrounding this single central cell, processes of ensheathing cells resulting in a lamellated appearance were determined (**Figures 1a and 1b**). Some of the ensheathing cell processes exhibited a vacuolated appearance (**Figure 1b**).

Electron microscopy. The dermal compartment reflected the known structural features of a dense irregular connective tissue rich in thick collagen fiber bundles, scattered fibroblasts and their processes. Lamellated bodies are characterized by central filament rich large cells and surrounding cytoplasmic processes of ensheathing cells, some of which are vacuolated (**Figures 2a and 2b**). Examination of the central cell at higher power magnification revealed its ultrastructure as a cell, which is extremely rich in intermediate filaments (**Figure 3**). The ultrastructure of cytoplasmic processes of ensheathing cells revealed the features of cell processes consisting of moderate numbers of organelles (**Figure 3**). In the examination of vacuolated samples of such ensheathing cell processes, almost no intracytoplasmic organelles were determined (**Figure 4**). Glomus bodies were surrounded by capsule and centrally located numerous rounded cells which reflected the structural features of an active cell, being rich in organelles and having an euchromatin rich nucleus (**Figure 5**).

Discussion. Several authors report the presence of subungual glomus tumors.[7-10,12-17] According to these authors, the etiology of these tumors was the extensive proliferation of the glomus cells. Although Moor et al[7] and Nakamura[8] described the light microscopic structure of the glomus cells, there is no study in the literature reporting the light microscopic and electron microscopic structure of the subungual glomus body. Subungual glomus tumors form the basis of all the structural findings related with this subject. Therefore, we investigated the organ from normal tissue specimens at light and electron microscopic levels to obtain further evidence for the characterization of the organ. During this examination, aside from the subungual glomus

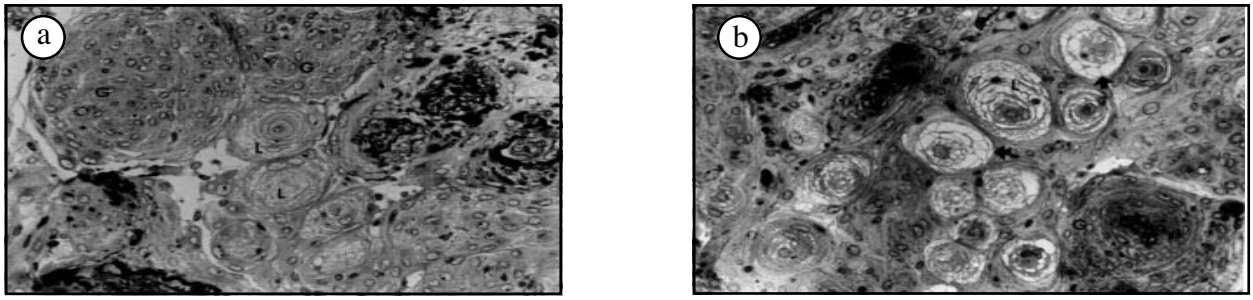

Figure 1 - Photomicrographs showing the sections through subungual tissue **a)** demonstrating glomus bodies (G) and lamellated bodies (L). Their close association is seen. **b)** Lamellated bodies have a vacuolated appearance (arrows). (Original magnification x 10).

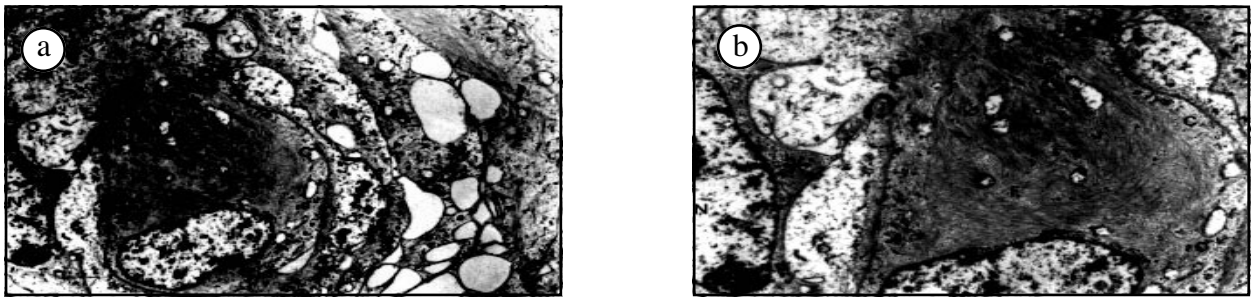

Figure 2 - Low and medium power electron micrographs of a lamellated body. Central cell (C), processes of ensheathing cells (*) and the nucleus of an ensheathing cell (N) are seen. The central cell is seen to be extremely rich in intermediate filaments (F) occupying almost its entire cytoplasm. **a)** Original magnification x 3000 and **b)** Original magnification x 5000).

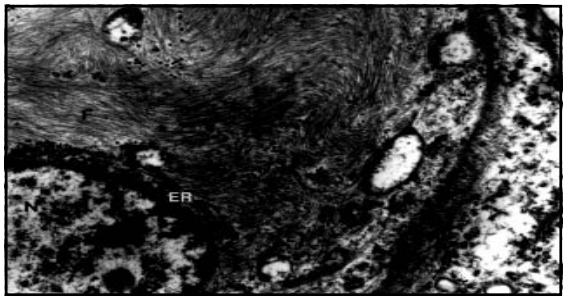

Figure 3

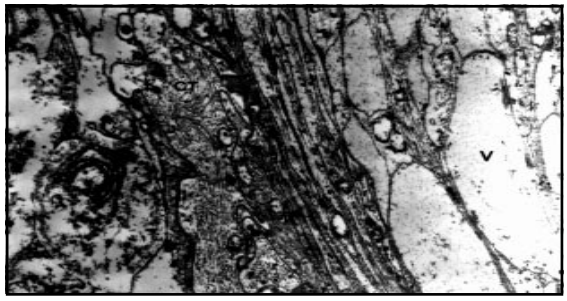

Figure 4

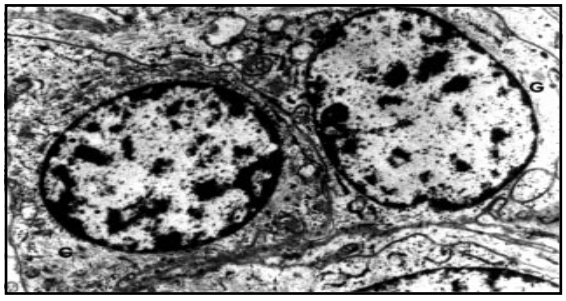

Figure 5

Figure 3 - Higher power electron micrograph demonstrating ultrastructural features of a central cell of a lamellated body. Euchromatin rich nucleus (N), few cisternae of granular endoplasmic reticulum (ER) in the perinuclear cytoplasm and extensive amounts of intermediate filaments (F) filling the remainder of the cytoplasm are seen. A portion of ensheathing cell cytoplasm, which is almost devoid of filaments with few organelles is also seen (Original magnification x 12000).

Figure 4 - Medium power electron micrograph of a glomus body, showing vacuolated processes of several ensheathing cells (V) and adjacent compartment, consisting of organelle rich cytoplasmic processes of connective tissue cells (CT) (Original magnification x 6000).

Figure 5 - Medium power electron micrograph of 2 glomus cells (G) within a glomus body. Both cells have euchromatin rich rounded nuclei and their cytoplasm is relatively organelle rich (Original magnification x 5000).

body, we observed a second structure; the lamellated body, in close association with the subungual glomus body. Due to its very interesting structure, we also defined the lamellated body at the electron microscopic level. The location and structural features of the lamellated body showed that, it might have a receptor associated or receptor related function.

The lamellated bodies are very unusual structures not found in any other part of the body. They contain a central filament rich cell, and many ensheathing cells not reported previously. The structural organization of these ensheathing cells in the lamellated bodies greatly resembles many skin associated receptors. Therefore, we planned future studies by using immuno-histochemistry, to reveal nervous elements for structural contribution, as we could not determine typical synaptic contacts at the electron microscopic examination of these tissue samples.

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